Testimony of Under Secretary for Science Paul Dabbar
U.S. Department of Energy
Before the
U.S. House Committee on Science, Space & Technology

January 30, 2018

INTRODUCTION

Thank you Chairman Smith, Ranking Member Johnson, and Members of the Committee. It's an honor to discuss with you the vital scientific and technological mission that the Department of Energy (DOE) performs on behalf of the American people.

I have been asked to speak about the Department's recent reorganization and also to provide an overview of our research portfolio.

Last month, the Secretary announced his reorganization of the Department, in order to deploy its resources more effectively and efficiently to address present and future challenges, and return the Department to its statutory framework. As the President and the Secretary have made clear, the Administration's priorities are achieving U.S. energy dominance, protecting our energy and national security, management of the environmental legacy, and advancing science and innovation.

The Department has now separated the Office of the Under Secretary for Science and Energy (established in 2013) into two Under Secretary positions, restoring the three Under Secretaries outlined in the statute[1]: the Under Secretary of Energy, the Under Secretary for Science; and the Under Secretary for Nuclear Security, Administrator of the National Nuclear Security Administration (NNSA).

As Under Secretary for Science, I will focus on basic scientific research, innovation, and environmental cleanup. Accordingly, included under the Under Secretary for Science are the Department's Office of Science, the Office of Technology Transfer, the Office of Environmental Management, the Office of Legacy Management, and the National Laboratory Operations Board. I'd like to provide you some additional context on those missions.

DOE OFFICE OF SCIENCE

The Office of Science (SC) mission is to deliver scientific discoveries and tools to transform our understanding of nature, advancing the energy, economic and national security of the United States. SC is and has long been the Nation's largest Federal sponsor of basic research in the

[1] 42 USC 7132 Principal Officers

physical sciences and the lead Federal agency supporting fundamental scientific research for our Nation's energy future.
SC investments and accomplishments in basic research and enabling research capabilities have provided the foundations for new technologies, businesses, and industries, significantly contributing to our nation's economy, national security, and quality of life.

SC supports a balanced research portfolio of basic scientific research in high energy, nuclear, and plasma physics; materials and chemistry; biological and environmental systems; applied mathematics; next generation high-performance computing and simulation capabilities; and basic research for advancement in new energy technologies. SC currently supports over 23,000 investigators at over 300 U.S. institutions and all 17 of the Department of Energy (DOE) laboratories.

SC also provides the Nation's researchers with 27 state-of-the-art national scientific user facilities, including supercomputers, x-ray light sources, particle accelerators, reactors, specialized facilities for nanoscience and genomics, and other facilities. These facilities offer capabilities unmatched anywhere in the world for over 31,000 researchers from universities, national laboratories, industry, and international partners.

SC oversees 10 of the 17 DOE national laboratories: Ames Laboratory, Argonne National Laboratory (ANL), Brookhaven National Laboratory (BNL), Fermi National Accelerator Laboratory (FNAL), Lawrence Berkeley National Laboratory (LBNL), Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory, Princeton Plasma Physics Laboratory, SLAC National Accelerator Laboratory (SLAC), and Thomas Jefferson National Accelerator Facility.

The Office of Science carries out its activities through six research program offices: Advanced Scientific Computing Research (ASCR), Basic Energy Science (BES), Biological and Environmental Research (BER), Fusion Energy Sciences (FES), High Energy Physics (HEP), and Nuclear Physics (NP). I'd like to spend a little time highlighting some of their recent progress.

Advanced Scientific Computing Research

The ASCR program is advancing applied mathematics and computer science; delivering the most advanced computational scientific applications in partnership with disciplinary science; advancing computing and networking capabilities; and developing future generations of computing hardware and software tools for science and engineering, in partnership with the research community, and U.S. industry. The ASCR program gives the science and technology community access to world-class supercomputers and the science and engineering tools, by developing and maintaining world-class computing and network facilities for science; and advancing research in applied mathematics, computer science, and advanced networking.

For more than half a century, the U.S. maintained world-leading computing capabilities through sustained investments in research and the development and deployment of new computing systems. The benefits of U.S. computational leadership have been enormous – huge gains in workforce productivity, an acceleration of progress in both science and engineering, advanced manufacturing techniques and rapid prototyping, nuclear stockpile stewardship without testing, and the ability to explore, understand and harness natural and engineered systems that are too large, too complex, too dangerous, too small or too fleeting to explore experimentally.

Today's computing capabilities are becoming increasingly costly and risky, with competition for U.S. dominance in computing arising from significant new investments and advancements in Asia and Europe. Computing impacts every sector of our economy and every field of science and engineering.

DOE and its predecessor organizations have advanced U.S. computing capabilities by partnering with U.S. computing vendors and researchers. Public-private partnerships remain vital as we push our state-of-the-art fabrication techniques to their limit to develop an exascale-capable (a billion billion operations per second) system while simultaneously preparing for the end of the current technology (current hardware and software).

Maximizing the benefits of U.S. leadership in computing in the coming decades requires an effective national response to increasing demands for computing capabilities and performance, emerging technological challenges and opportunities, and competition with other nations.

Currently, the Exascale Computing Project (ECP), sponsored jointly by ASCR and NNSA Advanced Simulation and Computing (ASC), is ASCR's highest priority, fostering an unprecedented level of collaboration among experts in hardware, software, and applications, with lab and academic experts and industry, with the intent to deploy an exascale-capable system by 2021.

Progress toward exascale is also visible on the hardware front. Deployment is underway at Oak Ridge for DOE's first "pre-exascale" machine, the 200-petaflop Summit, incorporating IBM and NVIDIA technology. Deployment is on track, and Summit is expected to be up and running this fiscal year.

ASCR is also looking beyond exascale by supporting research in Quantum Information Systems, the next horizon in the information economy. ASCR supports four scientific user facilities: the National Energy Research Scientific Computing Center and the Energy Sciences Network (ESnet); the Oak Ridge Leadership Computing Facility at ORNL; and the Argonne Leadership Computing Facility at ANL.

Basic Energy Science

BES supports fundamental research to understand, predict, and ultimately control matter and energy at the electronic, atomic, and molecular levels in order to provide the foundations for new energy technologies and to support the Department's missions in energy, environment, and national security. This research provides a knowledge base to help understand, predict, and ultimately control the natural world, helping build the foundation for achieving a secure and sustainable energy future.

Materials can now be built with atom-by-atom precision; chemical processes at the molecular scale can be controlled with increasing accuracy; and computational models can predict the behavior of materials and chemical processes before they exist.
BES also provides for the operations of five x-ray light source facilities, five nanoscale research centers, and two neutron scattering facilities. Upgrades are underway to two of the x-ray light sources facilities, the Linac Coherent Light Source-II at SLAC, and the Advanced Photon Source at ANL, to maintain U.S. competitiveness in this area.

Biological and Environmental Research

BER supports transformative science and scientific user facilities to achieve a predictive understanding of complex biological, earth, and environmental systems for energy and infrastructure security and resilience.

BER research seeks to discover the principles that guide the translation of the genetic code into the functional proteins and the metabolic and regulatory networks underlying the systems biology of plants and microbes as they respond to and modify their environments. This predictive understanding will enable design and reengineering of microbes and plants for improved energy resilience and sustainability, including improved biofuels and bioproducts, improved carbon storage capabilities, and controlled biological transformation of materials such as nutrients and contaminants in the environment.

BER research also advances the fundamental understanding of dynamic, physical, and biogeochemical processes required to systematically develop Earth System models that integrate across the atmosphere, land masses, oceans, sea ice, and subsurface required for predictive tools and approaches needed to inform policies and plans for future energy and resource needs.

BER's scientific impact has been transformative. Mapping the human genome through the U.S.-supported international Human Genome Project that DOE initiated in 1990 ushered in a new era of modern biotechnology and genomics-based systems biology.

BER also supports the operations of three scientific user facilities: the DOE Joint Genome Institute, the Environmental Molecular Sciences Laboratory, and the Atmospheric Radiation Measurement Climate Research Facility.

Fusion Energy Sciences

The FES program supports basic research and facilities to expand the fundamental understanding of plasma at very high temperatures and densities, and to build the scientific foundation needed to develop a fusion energy source.

To achieve these research goals, FES invests in flexible U.S. experimental facilities of various scales, international partnerships leveraging U.S. expertise, large-scale numerical simulations based on experimentally validated theoretical models, development of advanced fusion-relevant materials, and invention of new measurement techniques.

FES also supports discovery plasma science, including research in laboratory plasma astrophysics, low-temperature plasmas, small-scale magnetized plasma experimental platforms, and high-energy-density laboratory plasmas. Some of this work is jointly supported with the National Science Foundation (NSF).

High Energy Physics

The HEP program seeks to understand how the universe works at its most fundamental level by discovering the elementary constituents of matter and energy, probing the interactions between them, and exploring the basic nature of space and time.

The HEP program is guided by the May 2014 report of the High Energy Physics Advisory Panel Particle Physics Project Prioritization Panel, *Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context*:

- *Energy Frontier*: Researchers accelerate particles to the highest energies ever made by humanity and collide them to produce and study the fundamental constituents of matter. This requires some of the largest machines ever built including the Large Hadron Collider at the European Organization for Nuclear Research, known as CERN. This facility is 17 miles in circumference, and accelerates and collides high-energy protons while sophisticated detectors, some the size of apartment buildings, observe newly produced particles, with insight into fundamental forces of nature and the conditions of the early universe.

- *Intensity Frontier*: Researchers use a combination of intense particle beams and highly sensitive detectors to make extremely precise measurements of particle properties, study some of the rarest particle interactions predicted by the Standard Model of particle physics, and search for new physics. Measurements of the mass and other properties of neutrinos may have profound consequences for understanding the evolution and ultimate fate of the universe.

- *Cosmic Frontier*: Researchers use naturally occurring cosmic particles and phenomena to reveal the nature of dark matter, understand the cosmic acceleration caused by dark energy and inflation, infer certain neutrino properties, and explore the unknown. The highest-energy particles ever observed have come from cosmic sources, and the ancient light from the early universe and distant galaxies allows the distribution of dark matter to be mapped and perhaps the nature of dark energy and inflation to be unraveled. Ultra-sensitive detectors deep underground may glimpse the dark matter passing through Earth. Observations of the cosmic frontier may reveal a universe far stranger than ever thought possible.

  The Dark Energy Survey experiment produced its first precision measurements of dark energy. The results, within the 5% measurement uncertainty, are consistent with dark energy being an inherent property of the universe as opposed to a new kind of force. Work continues apace on the joint DOE-NSF Large Synoptic Survey Telescope (LSST). LSST will scan half of the sky repeatedly with optical and near-infrared imaging sensors, building up a "cosmic cinematography" of the changing universe, to further advance insight into dark energy.

Nuclear Physics

The mission of the NP program is to discover, explore, and understand all forms of nuclear matter. Although the fundamental particles that compose nuclear matter—quarks and gluons—are themselves relatively well understood, exactly how they interact and combine to form the different types of matter observed in the universe today and during its evolution remains largely unknown. Nuclear physicists seek to understand not just the familiar forms of matter we see around us, but also exotic forms such as those which existed in the first moments after the Big Bang and that exist today inside neutron stars, and to understand why matter takes on the specific forms now observed in nature.

NP provides for core research at universities and DOE national laboratories to support high priority research of the nuclear physics community, as well as the development of cutting-edge approaches for producing isotopes critical to the nation. NP supports operations of three scientific user facilities: the Relativistic Heavy Ion Collider at Brookhaven Lab for explorations of spin physics and intriguing new phenomena observed in quark gluon plasma formation; the Argonne Tandem Linac Accelerator System utilizing newly completed instrumentation; and the Continuous Electron Beam Accelerator Facility at Jefferson Lab, which recently completed its 12 GeV Upgrade. NP is also supporting the construction of the Facility for Rare Isotope Beams at Michigan State University, which will provide world-leading capabilities for nuclear structure and astrophysics research.

DOE BASIC AND APPLIED R&D COORDINATION

The Department has a long history of coordinating its basic and applied research programs in order to accelerate DOE mission goals. For example, the Office of Science's basic research offices and the DOE applied technology offices engage in ongoing efforts to coordinate their R&D activities through scientific and technical workshops, joint program planning and program reviews, shared Principal Investigator/contractor meetings, jointly coordinated solicitations, and program manager – level working groups.

Successful coordination on high performance computing, advanced materials research, electrical energy storage, advanced nuclear energy systems, and catalysis are just a few crosscutting areas that have been productive and ongoing for many years, facilitating better integration of the basic and applied research conducted by the science, engineering, and technology communities to advance American innovation. The DOE national laboratories are great examples of where this real R&D integration takes place.

As Under Secretary for Science, I have a statutory responsibility to coordinate the Department's basic research and applied technology programs and I intend to work closely with Under Secretary Menezes, as well as with the NNSA and EM, to develop formal collaboration mechanisms across our offices to accelerate innovation and advance energy technologies in targeted areas of priorities to the Secretary, including areas that will address our legacy waste clean-up needs.

ENHANCING TECHNOLOGY TRANSITIONS

The mission of the Office of Technology Transitions (OTT) is to expand the commercial impact of the DOE R&D portfolio, advancing U.S. economic, energy, and national security interests. OTT is helping to ensure access to the cutting edge results of DOE's early stage research across the DOE complex, program offices, and national laboratories. It pursues this mission by facilitating industry and other partnerships. To accelerate these interests, DOE recently authorized national lab contractors to use Agreements for Commercializing Technology. Adding to the existing available agreements, laboratories will have fewer barriers for potential business partners to access lab expertise and capabilities.

OTT is assuming responsibility for other DOE programs, as well as consulting with NNSA to boost national lab capability in working with industry. One example is the OTT Energy Investor Center, which directly facilitates national laboratories' engagement with investors and industry. The PNNL and National Grid recently announced a new major partnership, resulting from an OTT-facilitated roundtable held early in 2017.

ENVIRONMENTAL MANAGEMENT

The federal government's nuclear weapons production programs made significant contributions to our nation's defense, but this legacy includes an obligation for the Office of Environmental Management (EM) to address liquid radioactive waste, spent nuclear fuel and special nuclear material, transuranic and mixed and low-level waste, contaminated soil and water, and thousands of excess facilities.

The new alignment of the offices of SC and EM reporting to the Under Secretary for Science will create added momentum in environmental cleanup. By further leveraging the expertise of the national lab complex, and exploring various project management and contract approaches used by SC and EM, we hope to better manage costs and solve EM challenges, while ensuring the highest level of safety for our Federal and contractor employees, the public, and the environment.

We look forward to continued progress at key projects, including Low Activity Waste vitrification at Hanford and salt waste treatment at the Savannah River Site to significantly demonstrate risk reduction and progress in addressing our cleanup obligations.

CONCLUSION

While the modernization of DOE results in some changes, the core focus of energy dominance, protecting our energy and national security, management of the environmental legacy, and advancing science and innovation remains. The Administration strongly supports this reorganization around DOE's mission, and I look forward to answering your questions.